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ABSTRACT

The three objectives of this study were: (1) To investigate the changes in different teaching behaviors effected by different instructions alone, training alone and the interaction between them when they are combined; (2) To reveal the structure of interrelations among classroom activities, classified according to two category observation systems, Flanders Interaction Analysis Categories (FIAC) and Technion Diagnostic System (TDS), in different situations; and (3) To check empirically the assumptions underlying these two category observation systems in a peer teaching situation. Smallest Space Analysis was used to reveal the structure of intercorrelations among classroom activities in a 2 X 2 factorial design. It was shown that instructions cause a change in the interrelation structure while training does not. The relationship among classroom activities showed a two-dimensional porex pattern where joint direction for FIAC and TDS was student initation. Lateral direction was affective vs. instrumental for FIAC; knowledge vs. analytical and creative thinking for TDS. (Author/RC)

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THE STRUCTURE OF INTERRELATIONS AMONG CLASSROOM ACTIVITIES FOR DIFFERENT INSTRUCTIONS BEFORE AND AFTER TRAINING

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Paper presented at the annual meeting of the American Educational Research Association (A. E. R. A.) March/ April 1975, Washington, D. C.

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First Draft

ABSTRACT

Following Guttman ("it is the structure of empirical relationships among observation that is of interest to science"), Smallest Space Analysis was used to reveal the structure of intercorrelations among classroom activities in a 2x2 factorial design. The two factors manipulated were instructions and training; data were gathered through FIAC and TDS observation methods. It was shown that instructions cause a change in the interrelation structure while training does not. The relationship among classroom activities showed a two-dimensional porex pattern where joint direction for FIAC and TDS was student-initiation. Lateral direction was affective vs. instrumental for FIAC; knowledge vs. analytical and creative thinking for TDS.

February, 1975

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PREFACE

The Department of Laboratory Training of the Center for New Learning Methods (University of Tuebingen, West Germany, Zentrum fuer neue Lernverfahren der Universitaet), as well as the Teacher Training Department of Technion,(Israel Institute of Technology, Haifa, Israel) are developing elements of a Competency Based Teacher Education Program in microteaching format, aiming at an individualize training (Zifreund 1966, 1968, 1970; Klinzing 1975; Perlberg 1972).

To improve the decision making in developing these MT-courses for individualized teacher training, the German program included several research projects conducted at universities as well as at Teacher Training Institutes in West Germany and West Berlin (1), based on Microteaching-courses especially designed for the different types of teachers, starting on the second stage of their professional training (after their graduation from University).

The study reported here uses data from a Microteaching course conducted at a Teacher Training Institute for Secondary School teachers in West Berlin (Heilmann/ Klinzing 1974)[2.)]

1.) These studies were supported by the VW- foundation and the Deutsche Forschungsgemeinschaft, and conducted in cooperation of the Centerfor New Learning Methods, University of Tuebingen, West Germany, with the Teacher Training Department of the Technion, Israel Institute of Technology, Haifa, Israel.

2.) The microteaching course we are describing here was initiated by K. Heilmann, designed, conducted and evaluated by H.G.Klinzing, in cooperation with G. Eurich. The special evaluation with the SSA was done by Ehud Bar-On.

OBJECTIVES

The study has three objectives:

1. To investigate the changes in different teaching behaviors effected by different instructions alone, training alone and the interaction between them when they are combined.

2. To reveal the structure of interrelations among classroom activities, classified according to two different category observation systems, in different situations.

3. To check empirically the assumptions underlying these two category observation systems in a peer teaching situation.

THEORETICAL FRAMEWORK

At the Stanford University and more recently at the Far West Laboratories for Educational Research and Development (Borg et al. 1970, Peck and Tucker, 1974), at the Teacher Training Department in Haifa, Israel (Perlberg et al. 1972, 1974), and at the Center for New Learning Methods. (Klinzing 1975) teacher training in a Microteaching Laboratory has generated a persistent, cumulative body of research on the effects of this method.

Not only a microteaching training with "real pupils", but also a training in a peer teaching situation has shown its usefulness (e.g. Steinbach 1968, Davis and Smoot 1969, Nuthall 1972).

A change in classroom behavior, observed in a microteaching setting can also result from instructions before the training. For example, in the main field test report of Minicourse 4 Lai, Elder, Newman, and Gall state that "instructions to conduct a particular type of lesson (e.g. a Teacher Response lesson) have a definitive effect on use of response skills, both before and after training" (1973, p.24). For designing teacher training programs using microteaching techniques it may be important to investigate the question of the exact changes effected by each one of those experimental manipulations (instruction/ training) when used separately or used together.

In addition to the conventional method of answering such a question by using ANOVA to explore the different effects, another method was tried.

Following Guttman's suggestion (Guttman 1970) that "it is the structure of empirical relationships among observations that is of interest to science" we used Smallest Space Analysis (SSA) to achieve objectives 1 and 2. Since the educational researcher is not necessarily familiar with nonmetric analysis and since it is not possible to understand this study without comprehension of those methods, a short explanation is given.

Computer program SSA-I belongs to the nonmetric series developed by Guttman and Lingoes (Lingoes, 1973). The smallest space model deals, in general, with the multivariate analysis of ordered matrices (Lingoes 1966, 1968, Roskam 1968). A mapping functions relates elements of the data space to corresponding points of a representation (geometric) space. The input for SSA-I is a matrix of association coefficients (Pearson-Bravais product moment correlation, Kendall's Tau, Goodman and Kruskal's Gamma, etc.) among N variables. Each variable in the data space would be represented by a point in Euclidean space. The program seeks a solution for a minimum number of dimensions m, such that the following semi-strong monotonicity criterion shall be fulfilled for all pairs of variables in the correlation matrix (excluding the correlation between a variable and itself, i.e. the diagonal coefficients):

$$\text{If } r_{ij} > r_{kl}$$
$$\text{then } d_{ij} < d_{kl} \quad (i \neq k;\ j \neq l)$$

where:
$$d_{ij} = \sqrt{\sum_{a=1}^{m} (Xia - Xja)^2}$$

In other words, the mapping from the correlation matrix to the Euclidean space is based only on order relations. The higher the correlation between two variables, the closer they will appear in the space diagram (each variable appears as a point in the space diagram). SSA does not try to reproduce the exact values of the correlation matrix, as would be the case in factor analysis, but only their order.

It is possible to satisfy the monotonicity criterion described above in fewer dimensions than it is necessary to reproduce the metric information (whence the name-Smallest Space). In the analysis that will follow we are using only a two-dimensional space in order to reveal the structure of intercorrelations of 10 variables instead of

8 dimensions. (The N-2 dimensional solution is always possible and hence noninformative).

Nonmetric techniques do not introduce any assumptions about Gaussian distribution, homoscedasticity, etc. Although only weak constrains were imposed on the solution, the result was a set of distances which have ratio scale properties. With as few as 10 points (yielding $\frac{10 \times 9}{2}$ = 45 inequalities) embedded in two dimensions, we obtained a unique configuration.

A more intuitive way of explaining Smallest Space Analysis which may have more appeal to the nonmathematical reader is by the following example: Let us imagaine for a moment that the variables are towns of an unknown country and the correlations coefficients are the distances between each two towns. We can try to play a game in which we will try to reproduce the map of the unknown country from the table of distances among its towns. We make the game simple by deciding that we are not interested in preserving the original distances and it is only the relation of distance which is of importance to us, i.e. if town A is closer to town B than town C is to town D they will appear also as closer points on our map. It is easy to imagine that there will be no problem in drawing the first 3 or 4 points on our map, but the problem will become more and more difficult as one proceeds. Every additional town will require more and more distances to be taken into account. It is also probable that at one stage or another we will have to change the whole configuration since we will be unable to find a place for a town which will satisfy our rule of preserving the order of distances. In our example we are sure that a perfect solution to the problem does exist and it is only a matter of time to find it. Going back to variables and similarity coefficients we cannot be sure that there is a perfect solution in a two dimensional space and we can ask the computer either to give us the best solution for a two (or three) dimensional space telling us how good the fit was, or to tell us how many dimensions are needed for a satisfactory solution. In this study we have used two-dimensional space diagrams since in all cases they turned out to be quite satisfactory (coefficient of alienation .15).

The two category observation systems that were used were FIAC - Flanders Interaction Analysis Categories (Flanders 1965) and TDS - Technion Diagnostic System (Bar-On 1973). FIAC is an eclectic system which makes use of Rogerian (cat. 1 - accept feelings), Skinnerian (cat. 2 - reinforcement, praise) and other concepts. TDS is a set of categories which form a partial ordered Cartesian set of two ordered sets (facets) While FIAC observation system is well-known and therefore does not need to be described, a short description of the TDS is given. Actual categories of both systems are given in the appendices.

A MAPPING SENTENCE FOR TEACHERS' CLASSROOM BEHAVIOR

The student-teacher (P) uses

a_1 - verbal

a_2 - nonverbal

b_1 - lecturing

b_2 - giving instructions

b_3 - asking questions

b_4 - responding to pupil reaction

b_5 - responding to pupil initiative

in the level of

c_1 - imparting knowledge

c_2 - inducing analytical thinking

c_3 - inducing creative thinking

→ 0 : to : 100 frequency of 3-second time units

This mapping sentence provides a definitional system for the observed behaviors. The specification of order within the facet may be expressed in formal notation as follows:

$$a_2 \underset{A}{>} a_1 \dagger \qquad b_5 \underset{B}{>} b_4 \underset{b}{>} b_3 \underset{B}{>} b_2 \underset{b}{>} b_1 \qquad c_3 \underset{C}{>} c_2 \underset{C}{>} c_1$$

in the same way specification of a common notion of internal ordering will be written:

$$\underset{A}{>} \sim \underset{B}{>} \sim \underset{C}{>} \sim \; \dagger\dagger$$

stimulation of pupil participation

This means that, a_2 is greater than a_1 in the same sense that b_5 is greater than b_4 and in the same sense that c_3 is greater than c_2. They are all ordered from high to low stimulation of pupil participation. The three levels of thinking are equivalent to: applying a rule (c_1), inferring a rule (c_2) and creating a rule (c_3).

---

†. - The notation "$\underset{A}{>}$" means - "greater than" in the sense of A.

†† - The notation "$\sim$" means - "similar to".

The elements (structs) of each facet are arranged according to a common meaning - the amount of student stimulation, both intellectual and instrumental. Both systems deal with the instrumental domain, FIAC deals with the affective domain, while TDS deals with the cognitive domain (levels of thinking).

METHOD

The sample consisted of twenty secondary school beginning teachers from different disciplines. The microteaching course was conducted by the Center for New Learning Methods, Tuebingen University as a part of a competency-based Teacher Education program. (A more detailed description of the special method of microteaching training developed in this center can be found in Zifreund, W. 1966, 1968, 1970 and Klinzing, 1975). The teachers who served as subjects in this experiment were students of the Teacher Training Institute for secondary School Teachers in West Berlin (Heilmann and Klinzing 1974). The course plan consisted of theoretical lectures and exercises in the first week and laboratory training in the following two weeks. In the theoretical part, the FIAC system for coding and interpreting teacher behavior was practised and the students were instructed in behavioral objectives and in content analysis. Instructions and exercises were based on written materials, instructional films and video tapes.

The microteaching sessions took place in groups of five teachers each[1.]. The twenty participants conducted two ten-minute lessons both before (pre test)[2.] and after (post test)[3.] training. On both occasions, in the first lesson, labelled the Teacher Initiation Lesson (TIL), the teacher's main purpose was to maximize his colleague's achievements. In the second lesson, labelled the Teacher Response Lesson (TRL), the main purpose was to encourage student initiated ideas and to respond to them constructively. In his second lesson, each trainee used the same topic, but a different group of learners.

Training itself consisted of microteaching sessions in which each trainee conducted lessons ("TEACH") practicing one or more of the teaching skills developed in Stanford (Allen, D.W. and Ryan, K.A. 1968). According to a training system developed in Tuebingen, after each lesson the same topic is taken by another trainee who is a member of the same group and is taught by him to another group ("ALTERNATIVE TEACH"). Both the TEACH and ALTERNATIVE TEACH are videotaped and brought to the group for comparing and discussing. As a result of the conclusions that were reached in this discussion, the

1.) The peers were instructed not to role play, but rather to be themselves
2.) According to the MT-concept developed at the Center in Tuebingen, these two pre tests intended to give the trainees a framework for their subsequent training and a background for their individual decision-making when selecting or developing their objectives for the training sessions
3.) These post tests had two functions: In connection with the evaluation of the pre tests, they were used for self-evaluation and at the same time they served as diagnostic lessons. They were analyzed by the trai-

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first trainee conducted a third lesson ("RETEACH"). All lessons were videotaped, coded and interpreted by the trainees using the FIAC system.

DATA SOURCE

Each lesson was videotaped and coded twice by two trained observers who worked independently. The observer agreement was calculated by the modified Scott Coefficient (Flanders 1967). The coefficient calculated between each observer and a standard coding of a criterion tape exceeded 0.85.

Both observation systems made use of three-second time sampling. Th each ten-minute lesson was represented by 200 observations which served as raw data for the ANOVA and SSA.

RESULTS AND CONCLUSIONS

At first the changes in each of the ten categories of the FIAC[1] and four ratios, studied by Flanders (1970) and his colleagues[2], and furthermore 8 ratios from the 40 categories of the TDS[3] (which appeared frequently enough, Perlberg et al., 1972) were analyzed with a Three-Way-ANOVA, analyzing the effects of training alone, instruction alone, and the interaction between them when being combined.

Insert Table 1 here

In summary, the data reveal a significant increase due to training in Flanders' cat. 2 (praise, encouragement), cat.3 (accepting and using student ideas) and cat.4 (asking questions).

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1) For the definitions of the 10 categories, see appendix.
2) For the definitions of 4 ratios of Flanders, see appendix.
3) For the definitions of the 40 cat. of the TDS, see appendix.

Both training and instructions have a significant effect on the increase in cat.9 (student talk initiation), and a decrease in cat.5 (teacher lectures).
The interaction between instruction and training effects a decrease in cat 6 (teacher gives directions). Additional informations are given by the four EIAC ratios.

Insert Table 2 here

As summarized in table 2 the results show a significant increase in the Pupil Talk Ratio (PTR), in the Indirect/Direct Ratio (I/D), and the Teacher Response Ratio (TRR). There is also a significant effect of instruction on the PTR, I/D and the Pupil Initiation Ratio (PIR). The interaction between training and instructions is also significant for PTR.

Only eight TDS categories (out of forty) were frequent enough and therefore were used for the ANOVA.

INSERT TABLE 3 HERE

The results of the TDS data show a significant effect in teacher lecturing/ verbally/ knowledge (1,2) due to training and due to instruction; a significant decrease in teacher lecturing/verbally/ classroom management (1,1), teacher lecturing/ verbally/ knowledge (1,2) and an increase on teacher's relating to student ideas/verbally/ analytical (5,3), relating to student responses/non-verbally/analytical (student responses on the analytical level) (9,3), and in relating to nonverbally/analytical (Student initiation on the analytical level) (10,3).

In spite of using and reporting the ANOVA results, the authors are far from being satisfied with the use of this kind of analysis. The Conjoint Measurement which may be thought of as nonmetric "analysis of variance", would have been much more appropriate. Like SSA, it seeks a coordinate space but instead of distance function it uses a polynomial function. The question to be answered is if the additive model ($P_{b_i c_j} = X_{b_i} + X_{c_j}$) is the most suitable or if it is the distributive one, or even a

different model. Conjoint Measurements were not used because the computer program which deals with more than one case at a time is not completed. Even when using ANOVA it would be more appropriate to use multivariate ANOVA. Since the frequencies of the different categories are not independent (higher frequency of questions result in higher frequency of answers, using one category at a certain time point does not allow the use of another category at the same time, etc.) it would be more justified to decide on the first category to be analyzed, for the second category to use only the remaining variance, and so on. Otherwise, more variance than the variance which really exists is used. Unfortunately this type of ANOVA was not available to the authors when the analysis of the data was being carried out. Therefore it was decided to use BMDO8V for the sake of those readers who are used to parametric statistics which deals with the significance of difference among means. Main effects are detected, the reader has only to keep in mind that some of the significant effects are not independent.

As was explained above, the main contribution of this study is considered to be the analysis of the structure of the intercorrelation matrices.

Instead of dealing with the significance of differences between means, we are more interested in the relationship among the variables. We are interested in investigating how increases in teachers' questions, for correlation at a time does not have any meaning. Let us assume for a moment that we have a correlation coefficient of 0.4 (which is the dream of many social researchers). Is it a high correlation? Most of social researchers will agree that it is not a low correlation and some of them will probably ask if the correlation is significant. We have to remind those researchers who consider 0.4 as a "meaningful" relationship that correlation of 0.4 indicates that only about 16% of the variance in students' answers is accounted for by teachers' questions or, putting the same idea in a more embarrassing form, 84% of the answers are not explained by teachers' questions. The question about the significance of the correlation is also irrelevant. Significant correlation is a correlation which differs significantly from zero correlation, but why should one expect a zero correlation between questions and answers? Actually it will be much more reasonable to expect a low positive correlation and therefore a zero correlation would be a much more interesting result even though "not significant". In other words, it is meaningless to ask about a certain correlation if it is high or low or if it is significant or not. It is only the comparison of this correlation to all the other correlations, which exists among the variables of this universe of content, which is meaningful. What is done by using a SSA is considering all the interrelations among classroom activities simultaneously. It

is the structure of interrelations among variables and not their absolute value which is of importance.

To have a framework for comparison, we start with presenting the Smallest Space Analysis on the data gathered through the use of FIAC observation system from 515 lessons in seven microteaching courses. The teachers are from different populations (students, beginning teachers and experienced teachers) and the lessons were conducted under different Instructions (TRL, TIL, no instruction), at different stages of training.

Insert Table 4 here

As can be seen from the space diagram, four distinct pairs of categories can be identified: (3 - 9), (2 - 7), (4 - 8) and (6 - 10). The correlation (4 - 8) between teachers' questions and students' answers can be expected. It is also expected that a positive correlation will exist (3 - 9) between using student ideas by the teacher and students' initiations. However, while most of FIAC users will take this positive correlation as a general rule and therefore will train teachers to use more 3s as means of getting more 9s, we have found that the opposite can be expected in certain situations (e.g. discussion among peers). Neither is the positive correlation between (6 - 10) giving directions by the teacher and silence surprising, since carrying out of directions is usually associated with instrumental behavior that does not involve talking (at least this is the case in Germany). A little more surprising is the positive correlation between (2 - 7) teachers' praise and teachers' criticism and justification of authority. Usually, we tend to associate praising and encouragement with the "good", democratic teacher, while criticism and justification of authority are associated with the "bad", authoritarian teacher. Furthermore, we can think of praising and reinforcing as means of emotional control and then criticism is only the other side of the same coin. Therefore, it is not surprising that teachers who use more 2s tend to use also more 7s. Classroom activities are arranged in such a way that all the interactive styles are on one side while the non-interactive style (5) - teacher lecturing is on the other side. The FIAC system has only one category for non-interactive activity but we can predict that other categories which describe teachers' presentation activities, like "giving examples", "using transparancies", etc., would cluster around category 5. This is an example of deriving operational hypotheses to be checked in future studies. The interactive activities are arranged from teacher

initiation style (6 - 10), through (4 - 8) and (2 - 7), to student initiated style (3 - 9), where the student initiates ideas while the teacher is only responding by using the student's ideas. The emotional control style is half-way between the direct style (6 - 10) and indirect style (3 - 9), when the 7 is closer to the former and the 2 to the latter. Category 1 (teacher accepts feelings of a student) has a low correlation with all other categories and therefore lies in the middle, nearest to the emotional categories (2 and 7). This general structure changes when different instructions are given.

In PRE-TIL (Figure I) there is an axis running from student-initiated (3 - 9), through teacher initiated interactive style (4 - 8), styled of affective control (2 - 7) and instrumental control (6 - 0), to a non-interactive style of teacher lecturing (5). Teachers using praise (cat. 2) are also using criticism (7) for controlling their students. On the other hand, the (6 - 0) style of giving directions is more content oriented, where the (3 - 9) style is closer to the former while the drill style (4 - 8) to the latter. Before training and without special instructions for student initiated lessons, a clear distinction between different teaching styles appears. This structure is typical for teachers in the field.

Insert Table 5 here

In PRE-TIL the drill (4 - 8) and the affective control (2 - 7) styles are still distinct, while the style of controlling through directions (6 - 0) is inhibited by the TRL instructions and disappears. The most interesting result of the TRL instructions is breaking the connection between using student ideas (3) and student initiative (9). Teachers who used to lecture (5) are doing the thing pretending that they are developing student ideas, but there is a negative correlation between these attempts and student initiative. The more the teacher talks, the less the student initiates. In the case of peer teaching, students need neither the teachers use of their ideas (3) nor his praise (2). Polarization is between student and teacher initiation. The past of the lesson which is teacher initiated is divided between control (questions and answers, praise and criticism) and the teacher presenting his own (5) and student ideas (3). In comparison, Flanders' classification is more value-oriented than empiric. Evaluation of teachers' activities depends on kind of lesson and learners - category 3, which is usually considered to facilitate student initiative, appears here as undesirable.

Insert Table 6 here

The TDS space diagram enables better understanding of the structure of interrelation since it also conveys information about level of thinking. Negative correlations between the teacher's use of student ideas, and student initiation exists only if those activities are pooled across different levels of thinking. The TDS reveals that student initiation in the analytical and creative levels are positively correlated with teacher lecturing and relating to pupils' ideas on the same levels. The conclusion of the FIAC space diagram about negative correlation is true only when teachers' lecturing and relating to pupil ideas are on the knowledge level.

Insert Table 7 here

The POST-TIL interrelation structure is essentially similar to that of PRE-TIL which proves that instructions are much more effective in changing the structure than training. The only change compared to PRE-TIL is that training integrates to some extent, the inquiry (4-8) and the affective (2-7) styles with praise (2) acting as the linkage.

Insert Table 8 here

In the POST-TRL combination of instructions and training effects is found. Training establishes again the (3 - 9) style, in contrast to the PRE-TIL where negative correlation existed. Lecturing style disappears as a main factor and there is polarization between teacher initiated (4 - 8 and 2 - 7) and student initiated interactive style (3 - 9).

Insert Table 9 here

The structure of interrelations among TDS categories remains nearly invariant under the different experimental manipulations. It should be noticed that the definitional system of the TDS aims at constructing a non-situation dependent teaching theory. Therefore it is not surprising that SSA of the matrix showed a two-dimensional

porexpattern, showing invariance from one kind of lesson to the other. Since a possible reason for the differences between FIAC and TDS may be trainees worked with FIAC (which stresses the affective domain not measured by TDS) more work should be done.

EDUCATIONAL SIGNIFICANCE

It was illustrated that analysing the structure of intercorrelation among classroom activities in different situations using different observation methods, can give a new insight into understanding the interrelationship among activities. This understanding is essential for any research on teaching. A deeper comprehension of the meaning of different categories can be acheived. For example, the location of category 3 or FIAC (teacher is using student ideas) between categories 4 and 2 provides us with some indication about the double meaning of this category. The usage of student ideas by the teacher can be understood as praise or encouragement, but it may also take the form of a probing question by which the teacher wants to gain wider understanding of the students' ideas. The location of category 3 between 2 and 4 is typical to certain situations. By looking for the relative location of categories 5, 3, and 9, the four pairs (4 - 8, 2 - 7, 6 - 0, and 3 - 9), etc. the authors can identify very easily different situations (e.g. TRL, TIL) and different stages of training.

The most impressing bind, was the stability of the structure. While the frequencies of occurance of different categories were completely changed, the fundamental structure remains unchanged. This result brought us to conclude that the only consistent thing in studying classroom activities is the structure of inter-relations among them.

As we have stated above, we are in a position now to identify different teaching strategies (e.g., discussion) by merely looking at the space diagrams of their SSAs. Can you, the reader, do the same? You can test yourself by examining tables 10-13. In those tables, space diagrams of four situations similar to the four presented in this paper, are given (based on a greater number of lessons). You can try to cover the title and guess which space diagram corresponds to what situation. Good luck!

Insert Tables 10-13 here

TABLE 1

Three-Way ANOVA for Analyzing the Effect of Training, Different Situations (Instruction) and Interaction Between Them

Means and F-Values are given for the ten FIAC Categories

Cat.	1		2		3		4		5		6		7		8		9		10	
Instruction*	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Pre-test	0.5	0.0	0.6	1.2	7.1	7.0	5.9	6.4	61.3	32.3	0.6	0.7	0.2	0.5	4.5	5.4	15.4	43.3	3.1	2.8
Post test	0.03	0.0	2.6	2.1	10.9	11.0	8.0	10.0	39.5	20.8	1.3	0.4	0.4	0.1	7.5	4.9	26.0	47.2	3.4	3.3
Training	2.54		8.01**		5.48*		6.20**		23.54***		0.77		1.09		1.2.		5.26*		0.21	
Instruc-tion	3.20		0.03		0.0		2.16		34.62**		1.24		0.01		1.71		85.49***		0.05	
Inter-action	2.54		2.31		0.01		0.92		4.13		5.18*		2.89		3.91		3.54		0.01	

*Instruction I - TIL
Instruction II- TRL

*p ≤ (0.05)
**p ≤ (0.02)
***p ≤ (0.01)

TABLE 2

Means and F-Values for Four FIAC-Ratios and Three-Way ANOVAfor Analyzing the Effect of Training, Different Situations (Instruction) and Interaction Between Them

Ratios	PTR		I/D		TRR		PIR	
Instruction	I	II	I	II	I	II	I	II
Pre-test	0.20	0.49	0.22	0.33	0.70	0.80	0.71	0.87
Post-test	0.34	0.53	0.37	0.54	0.85	0.94	0.74	0.88
Training	8.81***		15.34***		8.58***		0.26	
Instruction	88.66***		11.08***		2.00		16.00***	
Interaction	9.34***		0.88		0.01		0.01	

PTR= Pupil Talk Ratio

I/D= Indirect/Direct Ratio

TRR= Teacher Response Ratio

PIR= Pupil Initiation Ratio

*p < (0.05)
**p < (0.02)
***p < (0.01)

TABLE 3

Means and F-Values for the Eight Frequent Categories of the TDS

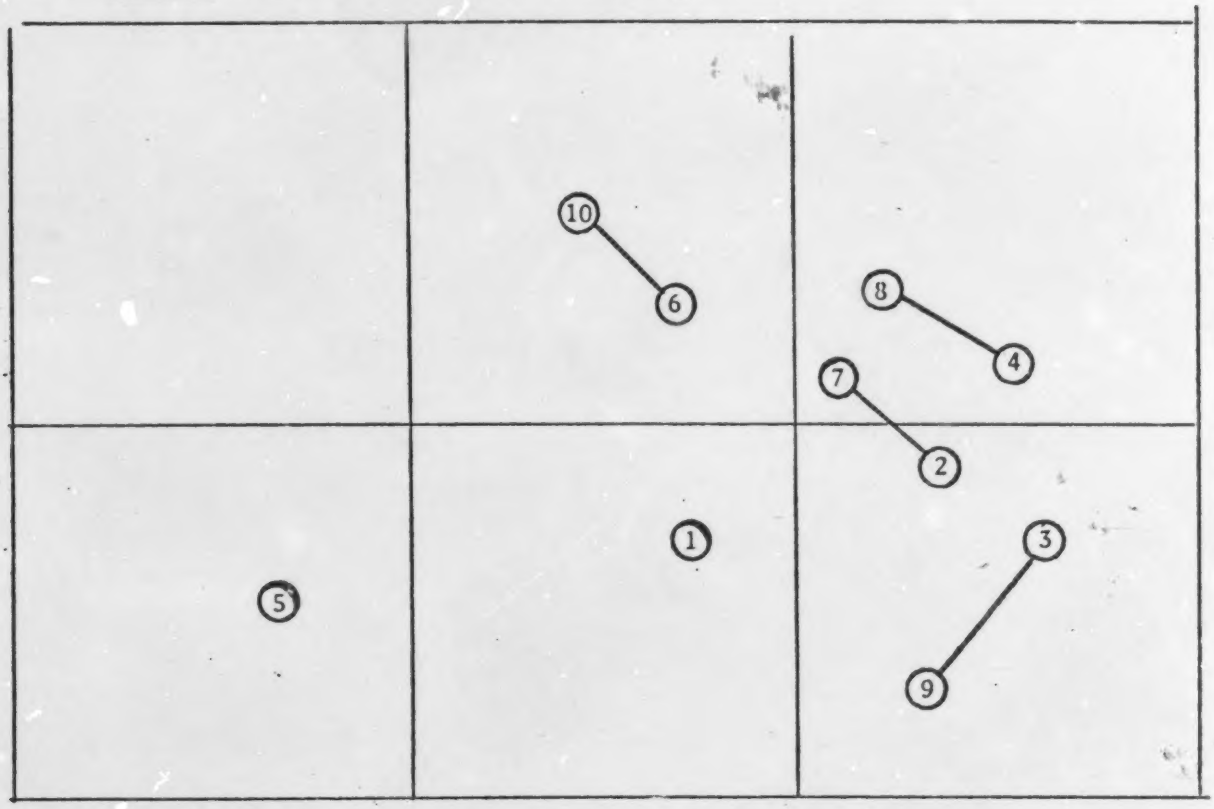
Three Way ANOVA for Analyzing the Effect of Training

Different Situations (Instruction) and Interaction Between Them

Ratios	1.1		1.2		9.2		1.3		5.3		9.3		10.3		10.4	
Instruction	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Pre-test	7.2	4.0	40.4	17.0	4.0	3.3	11.4	10.9	2.1	4.3	4.2	11.3	5.3	19.0	2.2	4.0
Post-test	5.6	3.3	27.8	13.9	5.1	5.6	10.2	6.7	2.5	4.6	7.6	12.3	7.9	17.2	6.5	6.1
Training	2.61		6.89**		2.63		3.98		0.21		3.27		0.05		3.87	
Instruction	7.85**		29.06***		0.02		1.98		5.53*		14.27***		28.19***		0.54	
Inter-action	0.31		2.98		0.84		1.06		0.00		0.60		3.96		3.63	

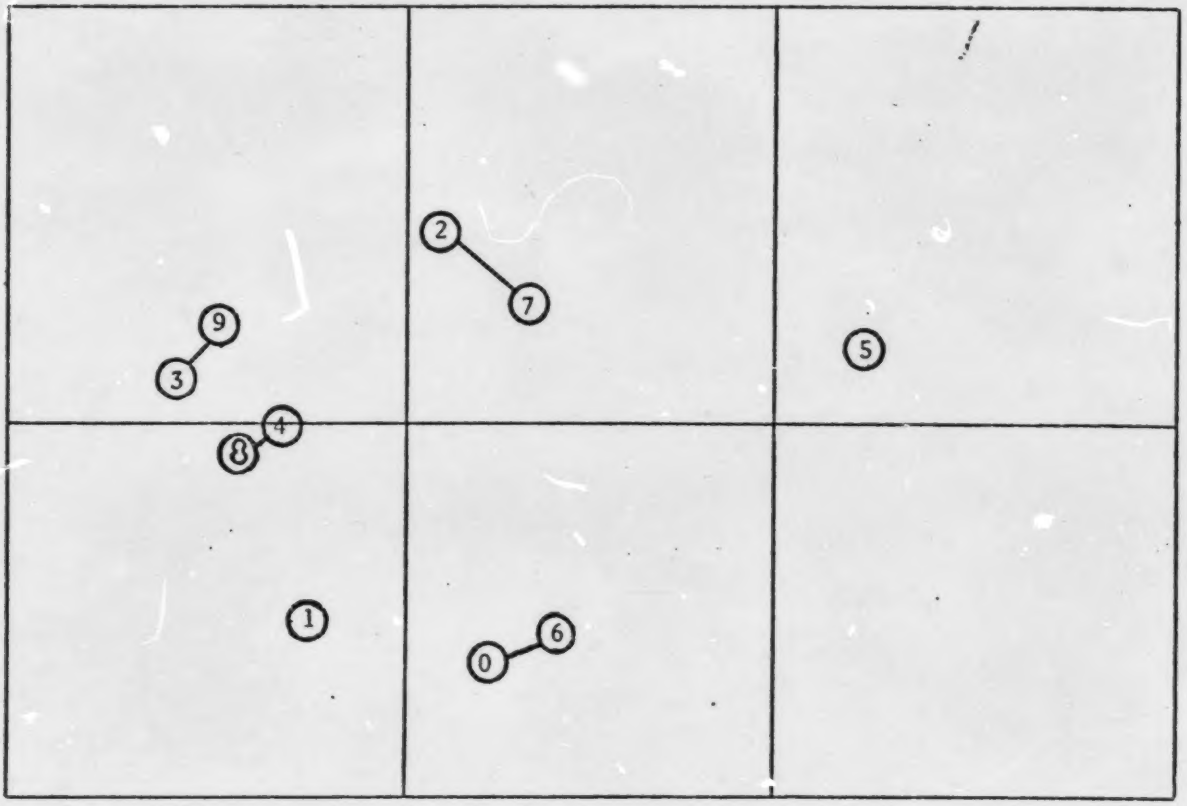
*p < 0.05
**p < 0.02
***p < 0.01

TABLE 4 - SSA-I of 515 Lessons - FIAC



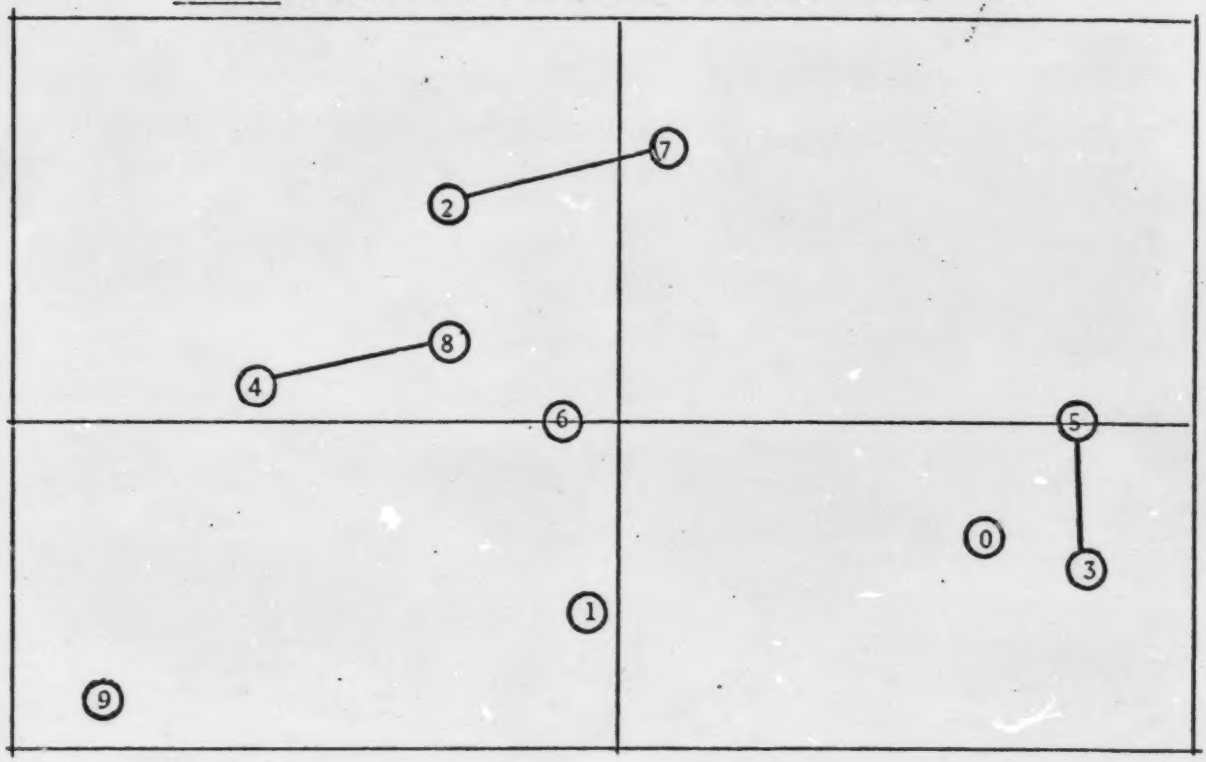
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	0.07	0.0								
Cat. 3	0.08	0.15	0.0							
Cat. 4	0.00	0.20	0.32	0.0						
Cat. 5	-0.08	-0.28	-0.46	-0.42	0.0					
Cat. 6	0.05	0.11	-0.13	0.07	-0.15	0.0				
Cat. 7	0.02	0.21	-0.03	0.16	-0.09	0.09	0.0			
Cat. 8	-0.03	0.22	0.06	0.43	-0.12	0.10	0.16	0.0		
Cat. 9	0.04	0.05	0.12	-0.08	-0.76	-0.04	-0.05	-0.30	0.0	
Cat.10	-0.01	-0.11	-0.07	0.06	-0.19	0.42	0.03	-0.01	-0.11	0.0

TABLE 5- SSA-I of Pretest I (TEACHER INITIATION LESSON) - FIAC



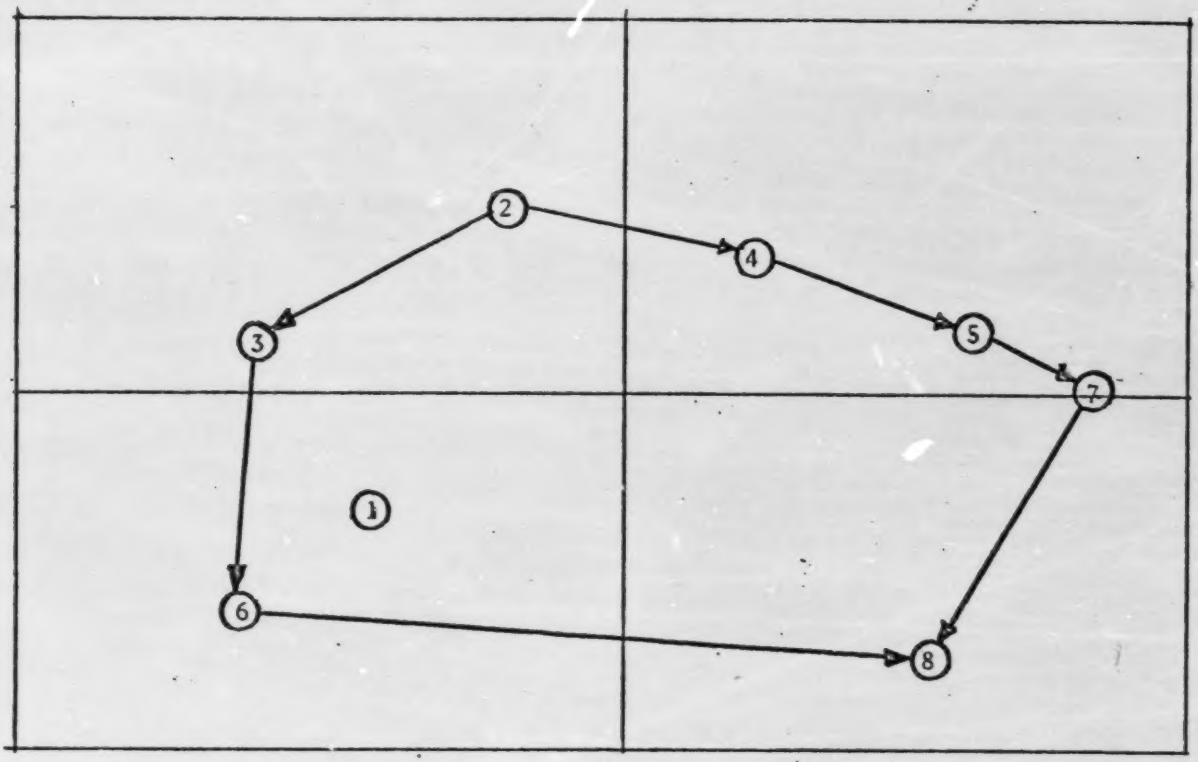
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	-0.21	0.0								
Cat. 3	-0.04	0.05	0.0							
Cat. 4	0.46	0.38	0.49	0.0						
Cat. 5	-0.26	-0.20	-0.71	-0.73	0.0					
Cat. 6	0.19	-0.16	-0.15	-0.11	-0.14	0.0				
Cat. 7	0.22	0.78	-0.16	0.29	-0.10	0.03	0.0			
Cat. 8	0.45	0.20	0.45	0.87	-0.74	-0.15	0.06	0.0		
Cat. 9	0.02	0.11	0.56	0.36	-0.81	-0.08	0.04	0.41	0.0	
Cat.10	0.06	-0.12	-0.10	-0.05	-0.21	-0.86	-0.10	-0.01	-0.09	0.0

TABLE 6- SSA of Pretest II (TEACHER RESPONSE LESSON) - FIAC



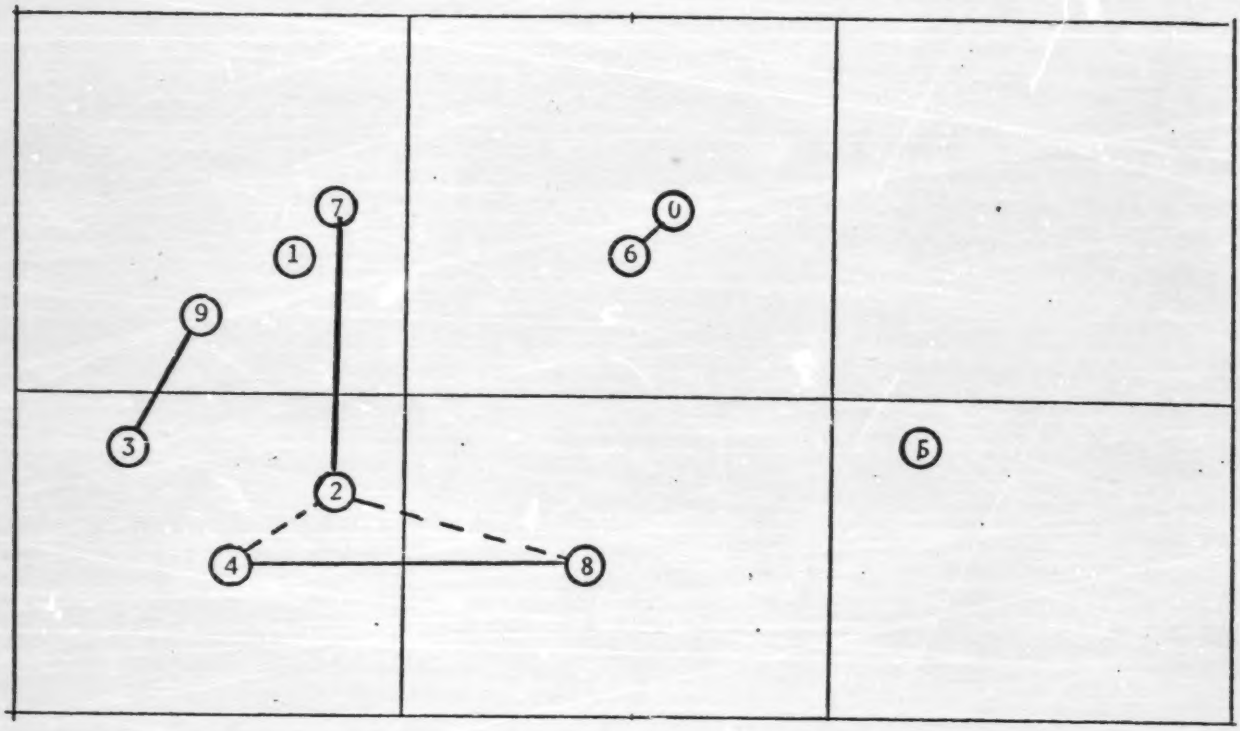
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	0.0	0.0								
Cat. 3	0.0	-0.25	0.0							
Cat. 4	0.0	0.19	-0.30	0.0						
Cat. 5	0.0	-0.10	0.92	-0.38	0.0					
Cat. 6	0.0	0.08	-0.10	0.26	-0.19	0.0				
Cat. 7	0.0	0.39	-0.18	-0.04	-0.02	-0.13	0.0			
Cat. 8	0.0	0.24	-0.23	0.76	-0.21	0.37	0.23	0.0		
Cat. 9	0.0	-0.15	-0.43	-0.09	-0.59	-0.22	-0.27	-0.30	0.0	
Cat.10	0.0	-0.31	0.70	-0.24	0.57	0.36	-0.15	-0.12	-0.52	0.0

TABLE 7- SSA of posttest I (TEACHER INITIATION LESSON) - TDS - DATA



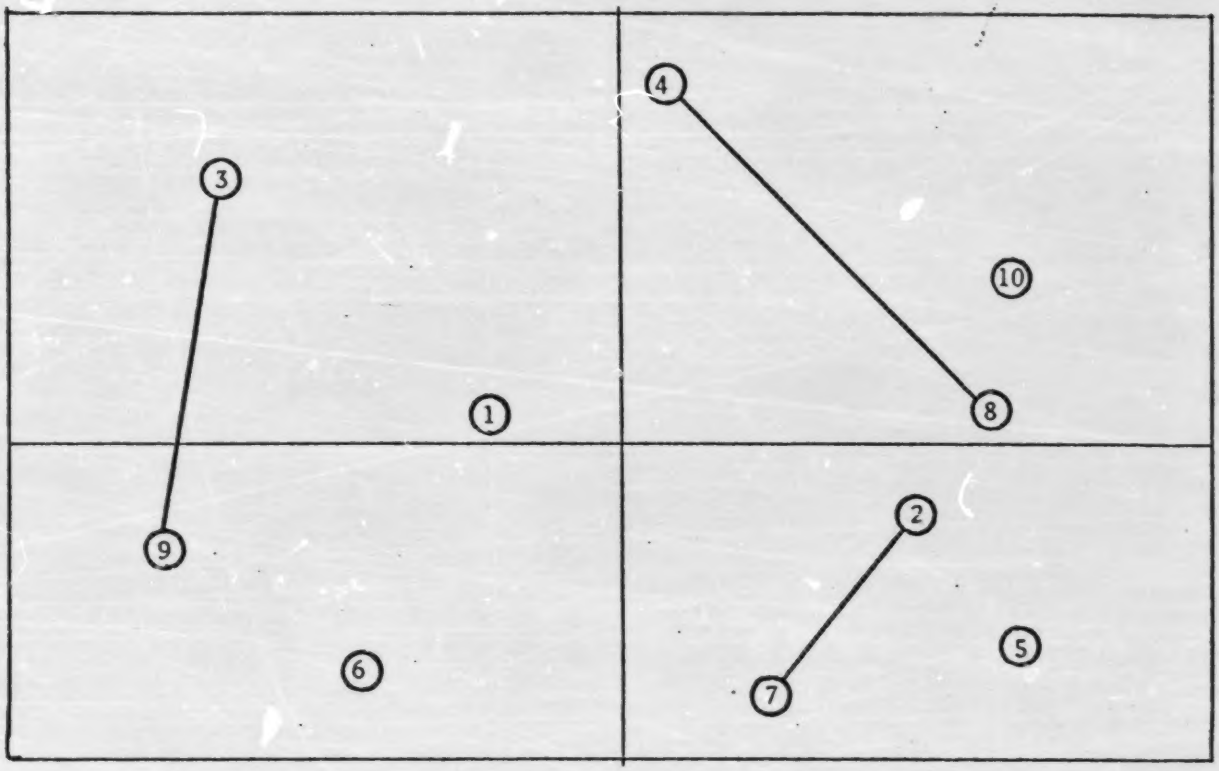
CATEGORY	1	2	3	4	5	6	7	8
Cat. 1	0.0							
Cat. 2	0.12	0.0						
Cat. 3	0.23	0.31	0.0					
Cat. 4	-0.14	0.23	-0.01	0.0				
Cat. 5	-0.07	-0.11	-0.47	0.42	0.0			
Cat. 6	0.49	-0.26	0.55	-0.15	-0.46	0.0		
Cat. 7	-0.40	-0.11	-0.58	0.08	0.50	-0.52	0.0	
Cat. 8	-0.43	-0.35	-0.26	-0.19	-0.02	-0.19	0.16	0.0

TABLE 8 - SSA of Posttest I (TEACHER INITIATION LESSON) - FIAC



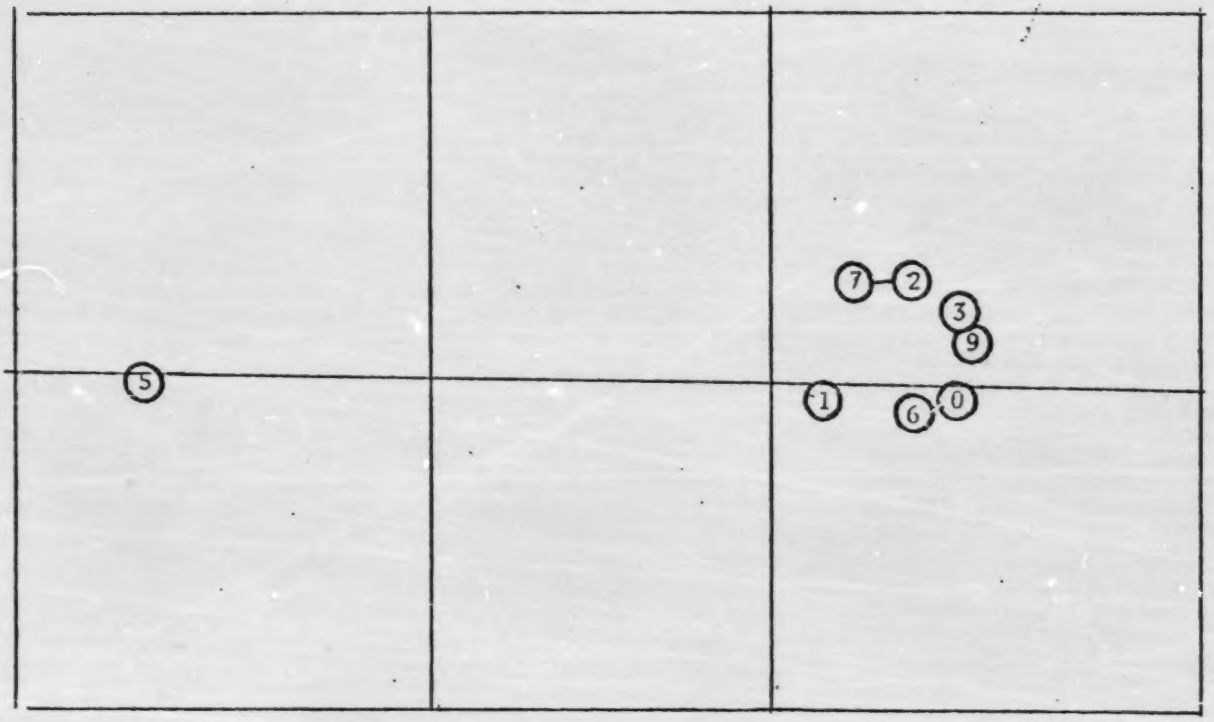
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	-0.00	0.0								
Cat. 3	0.22	-0.15	0.0							
Cat. 4	0.16	0.29	0.37	0.0						
Cat. 5	-0.30	-0.42	-0.58	-0.49	0.0					
Cat. 6	-0.08	0.06	-0.22	-0.38	0.01	0.0				
Cat. 7	0.50	0.11	-0.17	-0.02	-0.23	0.02	0.0			
Cat. 8	-0.12	0.20	-0.23	0.23	0.04	0.01	-0.10	0.0		
Cat. 9	0.27	0.31	0.30	0.19	-0.78	-0.21	0.38	-0.41	0.0	
Cat.10	-0.04	-0.14	-0.21	-0.46	0.12	0.81	0.01	-0.15	-0.26	0.0

TABLE 9 - SSA of Posttest II: Teacher Response Lesson - FIAC



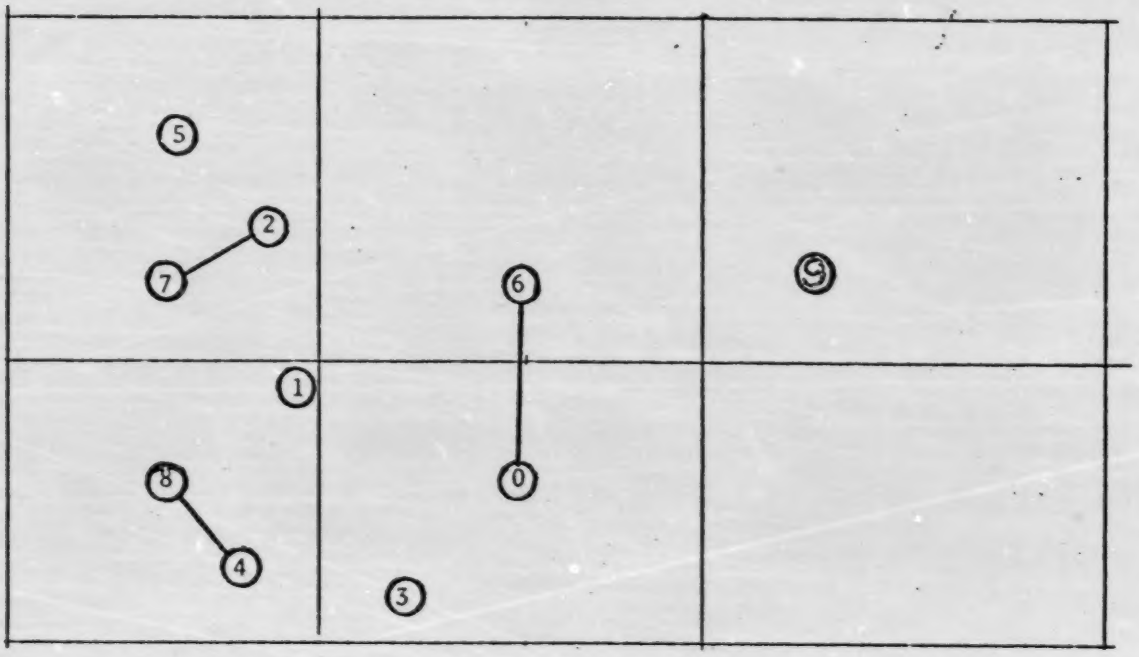
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	0.0	0.0								
Cat. 3	0.0	-0.50	0.0							
Cat. 4	0.0	-0.04	0.00	0.0						
Cat. 5	0.0	0.16	-0.40	-0.12	0.0					
Cat. 6	0.0	-0.25	0.15	-0.55	-0.07	0.0				
Cat. 7	0.0	0.27	-0.30	-0.01	0.33	0.25	0.0			
Cat. 8	0.0	0.27	-0.43	0.10	0.49	-0.15	0.12	0.0		
Cat. 9	0.0	-0.12	-0.01	-0.18	-0.78	0.16	-0.20	-0.62	0.0	
Cat.10	0.0	0.35	-0.27	0.22	0.23	-0.16	0.08	0.32	-0.43	0.0

TABLE 10- SSA of 81 Lessons (Pretest) - TIL- FIAC



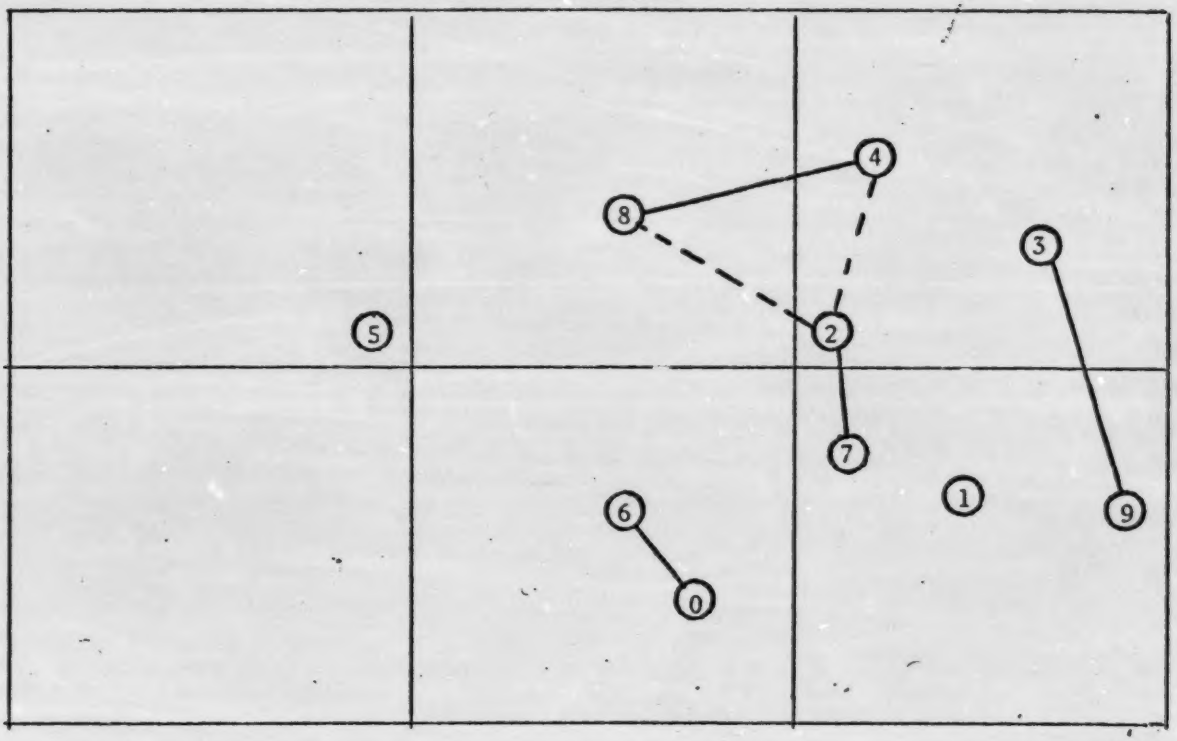
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	-0.11	0.0								
Cat. 3	0.01	0.30	0.0							
Cat. 4	0.17	0.47	0.58	0.0						
Cat. 5	-0.15	-0.54	-0.77	-0.76	0.0					
Cat. 6	0.19	0.08	0.07	0.03	-0.21	0.0				
Cat. 7	0.15	0.31	-0.04	0.26	-0.16	-0.02	0.0			
Cat. 8	0.24	0.34	0.45	0.80	-0.67	-0.00	0.19	0.0		
Cat. 9	0.09	0.41	0.55	0.38	-0.80	0.12	0.10	0.27	0.0	
Cat.10	-0.04	0.08	-0.03	-0.05	-0.23	0.36	-0.08	0.03	0.03	0.0

TABLE 11- SSA of 81 Lessons (Pretest Discussio-) - FIAC



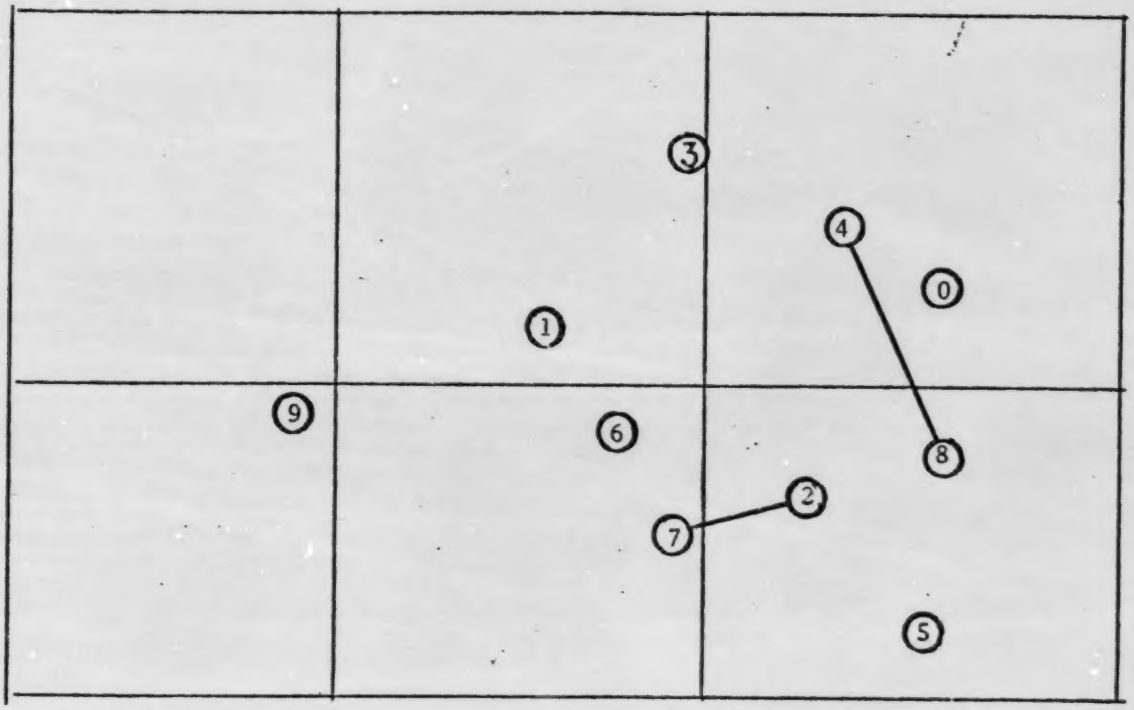
CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	0.10	0.0								
Cat. 3	0.10	-0.09	0.0							
Cat. 4	0.14	0.12	0.28	0.0						
Cat. 5	0.14	0.11	-0.22	-0.26	0.0					
Cat. 6	-0.06	0.20	-0.09	-0.08	-0.22	0.0				
Cat. 7	-0.07	0.24	-0.16	0.05	0.32	-0.06	0.0			
Cat. 8	-0.04	0.12	-0.02	0.51	-0.09	0.22	0.26	0.0		
Cat. 9	-0.20	-0.21	-0.32	-0.41	-0.61	0.06	-0.33	-0.44	0.0	
Cat.10	-0.01	-0.15	0.21	0.03	-0.24	0.23	-0.14	0.01	-0.13	0.0

TABLE 12 - SPACE DIAGRAM



CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	0.18	0.0								
Cat. 3	-0.04	-0.00	0.0							
Cat. 4	-0.06	0.17	0.32	0.0						
Cat. 5	-0.20	-0.33	-0.44	-0.39	0.0					
Cat. 6	-0.01	0.09	-0.17	-0.21	0.07	0.0				
Cat. 7	0.03	0.33	-0.03	-0.07	-0.13	-0.01	0.0			
Cat. 8	-0.07	0.18	-0.15	0.40	0.07	0.08	0.01	0.0		
Cat. 9	0.25	0.03	0.07	-0.18	-0.70	-0.21	0.10	-0.50	0.0	
Cat.10	-0.09	0.03	-0.15	-0.07	-0.07	0.46	-0.01	-0.19	-0.12	0.0

TABLE 13- SSA of 59 Lessons (Post-Discussion) - FIAC



CATEGORY	1	2	3	4	5	6	7	8	9	10
Cat. 1	0.0									
Cat. 2	0.0	0.0								
Cat. 3	0.0	-0.18	0.0							
Cat. 4	0.0	-0.02	0.27	0.0						
Cat. 5	0.0	0.08	-0.29	-0.16	0.0					
Cat. 6	0.0	0.11	0.06	0.04	-0.05	0.0				
Cat. 7	0.0	0.28	-0.08	-0.02	0.03	0.21	0.0			
Cat. 8	0.0	0.28	-0.13	0.38	0.16	0.17	0.07	0.0		
Cat. 9	0.0	-0.25	-0.24	-0.51	-0.59	-0.10	-0.09	-0.62	0.0	
Cat.10	0.0	0.17	0.08	0.28	-0.02	-0.11	0.07	0.11	-0.37	0.0

APPENDIX 1

Flanders' Interaction Analysis Categories* (FIAC)

Teacher Talk	Response	1. Accepts feeling. Accepts and clarifies an attitude or the feeling tone of a student in a nonthreatening manner. Feelings may be positive or negative. Predicting and recalling feelings are included. 2. Praises or encourages. Praises or encourages students; says "um hum" or "go on"; makes jokes that release tension, but not at the expense of a student. 3. Accepts or uses ideas of students. Acknowledges student talk. Clarifies, builds on, or asks questions based on student ideas.
		4. Asks questions. Asks questions about content or procedure, based on teacher ideas, with the intent that a student will answer.
	Initiation	5. Lectures. Offers facts or opinions about content or procedures; expresses his own ideas, gives his own explanation, or cites an authority other than a student. 6. Gives directions. Gives directions, commands, or orders to which a student is expected to comply. 7. Criticizes student or justifies authority. Makes statements intended to change student behavior from nonacceptable to acceptable patterns; corrects student answers; bawls someone out. Or, states why the teacher is doing what he is doing; uses extreme self-reference.
Student Talk	Response	8. Student talk--response. Student talk in response to teacher contact which structures or limits the situation. Freedom to express own ideas is limited.
	Initiation	9. Student talk--initiation. Students initiate or express own ideas either spontaneously or in response to teacher's soliciting initiation. Freedom to develop opinions and a line of thought; going beyond existing structure.
Silence		10. Silence or confusion. Pauses, short periods of silence, and periods of confusion in which communication cannot be understood by the observer.

* There is no scale implied by these numbers. Each number is classificatory; it designates a particular kind of communication event. To write these numbers down during observation is to enumerate, not to judge a position on a scale. Based on Ned A. Flanders, Analyzing Teaching Behavior, 1970.

THE FIAC RATIOS [1]

APPENDIX 2

37

1.) PTR ratio

This variable is the sum of the student talk tallies (cat. 8 + 9), divided by the sum of all categories

$$PTR = \frac{\text{cat. } 8,9}{\text{cat. } 1,2,3,4,5,6,7,8,9,10}$$

2.) I / D ratio

This variable provides a measure of the proportion of indirect to direct teacher behavior.
It is derived from the division of the sum of cat. 1, 2, 3 and 4 by the sum of the variables 1,2,3,4,5,6,7.

$$I / D = \frac{\text{cat. } 1,2,3,4}{\text{cat. } 1,2,3,4,5,6,7}$$

3.) TRR (i/d) ratio

The revised i/d ratio is used to find out the kind of emphasis given to motivation and control in a particular classroom.
The number of tallies in cat. 1,2,3 is divided by the number of tallies in cat. 1,2,3 plus those in cat. 6 and 7.

$$TRR\ (i/d) = \frac{\text{cat. } 1,2,3}{\text{cat. } 1,2,3,6,7}$$

This ratio eliminates the effects of cat. 4 and 5, lecture and asking questions, and gives information about whether the teacher is direct or indirect in his approach to motivation or control.

4.) PIR ratio

The PIR indicates the percentage of student talk which is student initiated.
It is derived from the summing up of the tallies in cat. 9 and its division by the sum of cat. 8 + 9.

$$PIR = \frac{\text{cat. } 9}{\text{cat. } 8,9.}$$

1.) PTR ratio

This variable is the sum of the student talk tallies (cat. 8 + 9), divided by the sum of all categories

$$PTR = \frac{\text{cat. } 8,9}{\text{cat. } 1,2,3,4,5,6,7,8,9,10}$$

2.) I / D ratio

This variable provides a measure of the proportion of indirect to direct teacher behavior.
It is derived from the division of the sum of cat. 1, 2, 3 and 4 by the sum of the variables 1,2,3,4,5,6,7.

$$I / D = \frac{\text{cat. } 1,2,3,4}{\text{cat. } 1,2,3,4,5,6,7}$$

3.) TRR (i/d) ratio

The revised i/d ratio is used to find out the kind of emphasis given to motivation and control in a particular classroom.
The number of tallies in cat. 1,2,3 is divided by the number of tallies in cat. 1,2,3 plus those in cat. 6 and 7.

$$TRR\ (i/d) = \frac{\text{cat. } 1,2,3}{\text{cat. } 1,2,3,6,7}$$

This ratio eliminates the effects of cat. 4 and 5, lecture and asking questions, and gives information about whether the teacher is direct or indirect in his approach to motivation or control.

4.) PIR ratio

The PIR indicates the percentage of student talk which is student initiated.
It is derived from the summing up of the tallies in cat. 9 and its division by the sum of cat. 8 + 9.

$$PIR = \frac{\text{cat. } 9}{\text{cat. } 8,9.}$$

1) Flanders (1970)

APPENDIX 3

The Categories of the Technion Diagnostic System (TDS)

Facets A, B:

1) Lecturing, verbally
2) Giving directions. verbally
3) Asking questions, verbally
4) Relating to pupil response, verbally
5) Relating to pupil initiation, verbally
6) Lecturing, non-verbally
7) Giving directions, non-verbally
8) Asking questions, non-verbally
9) Relating to pupil response, non-verbally
10) Relating to pupil initiative, non-verbally

Facet C:

1) classroom management
2) imparting knowledge
3) developing analytical thinking
4) developing creative thinking

The eight frequent categories which were used in the analysis:

1) 1-1: Teacher Lecturing/verbally/Classroom management
2) 1-2: Teacher Lecturing/verbally/imparting knowledge
3) 9-2: Teacher Relating to Pupil Response/non-verbally/knowledge (= pupil response/verbally/knowledge)
4) 1-3: " Lecturing/verbally/developing analytical thinking
5) 5-3: " Relating to pupil initiation/verbally/developing analytical thinking
6) 9-3: " Relating to pupil response/non-verbally/analytical (=pupil initiative/verbally/analytical)
7) 10-3: " Relating to pupil initiative/non-verbally/analytical (= pupil initiative/verbally/analytical)
8) 10-4: " Relating to pupil initiative/non-verbally/creative (=pupil initiative verbally/creative)

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E R R A T A

page 5: A third annotation should be added to the last sentence (..."creating a rule(c_3)" ' :

+++ This represents the TDS in its present modified version. Throughout this study, however, the original slightly different system has been used, for which the reader is requested to bear in mind the following modification:

c_1 classroom management
c_2 imparting knowledge
c_3 inducing analytical thinking
c_4 inducing creative thinking

page:	line:	instead of:	read:
11	9	(Figure 1)	(table 5)
11	18	PRE-TIL	PRE-TRL
12	15	PRE-TIL	PRE-TRL
30	ref. no.11	1975	1971